CLAIMS

What is claimed is:

1. A plastic tube heat exchanger utilizing for separation of one heat exchange fluid from another heat exchange fluid multilayered plastic tubes wherein at least one of the layers is at least 50% by weight of polyamide resin and at least one of the layers is at least 50% by weight thermotropic liquid crystal polymer blended with other polymer to make it tough enough so that in the form of 1.5 mm outside-diameter tube it can be bent around a radius of 12.5 mm without cracking or delaminating.

2. The heat exchanger of claim 1 wherein the tubing can withstand an internal pressure of 10,300 kPascals without bursting.

3. The heat exchanger of claim 1 wherein the liquid crystal polymer is toughened by melt blending with small particles of rubber or other low-crystallinity polymer about 2 to about 30 percent by weight of the total weight of the liquid crystal polymer and rubber or other polymer rubber or other polymer having low crystallinity having reactive functional groups.

4. A plastic tube heat exchanger having a set of at least three plastic tubes positioned around a surface having the shape of a closed curve and on a multiplicity of spaced-apart spacers which hold said tubes in a spatial relation to each other, said spacers providing a generally planar base, to form a layer of tubes, said base being generally perpendicular to said

surface, wherein the set of tubes is positioned on said base in a generally planar relation to form a layer, with a first tube in said layer having an inward side adjacent said surface and an outward side opposite the inward side, a second tube in said layer proximate the first tube and on the outward side of said first tube opposite said surface, and each succeeding tube on the spacers with an inward side proximate the outward side of previous tube, with a first end of each of said tubes projecting off the base so that they can be joined together in a first header, where the layer of tubes is about to reach the part of said tubes that projects off of said base, the elevation of the set of tubes relative to the plate rises relative to the base so the next layer of tubes lies on the first layer of tubes with the first tube adjacent said surface, with a multiplicity of layers, each overlaying the previous layer to form a group of layers, the second end of each tube projecting away from said group, and the first end of said tubes joined together to form said first header and said second end of said tubes joined together to form a second header.

5. The plastic tube heat exchanger of claim 4 wherein the spacers in succeeding layers are held together by columns at the inner ends of each spacer in a layer.

6. The plastic tube heat exchanger of claim 4 wherein columns also hold together the outer ends of each spacer.

7. The plastic tube heat exchanger of claim 4 wherein said surface is generally circular.

8. The plastic tube heat exchanger of claim 4 wherein said surface has a curvilinear shape other than generally circular.

9. The plastic tube heat exchanger of claim 5 wherein said surface has a shape generally in the nature of a figure eight.

10. The plastic tube heat exchanger of claim 4 wherein a multiplicity of spaced-apart spacers are provided on top of each layer, configured so as to provide spacing both between tubes in a layer and between layers.

11. The plastic tube heat exchanger of claim 11 wherein at least three spacers are provided on each layer.

12. The plastic tube heat exchanger of claim 11 wherein the spacing within a layer is less than the spacing between layers.

13. The plastic tube heat exchanger of claim 4 wherein there are a multiplicity of tube groups, each with its own terminations.

14. The plastic tube heat exchanger of claim 4 wherein each row has from 3 to 100 tubes.

15. The plastic tube heat exchanger of claim 12 wherein each row has 15 to 30 tubes.

16. The plastic tube heat exchanger of claim 4 wherein each tube group has from 4 to 10 layers of tubes.

17. The plastic tube heat exchanger of claim 13 wherein the number of tube groups provided is from 3 to 10.

18. A plastic tube heat exchanger of claim 4 which is a refrigerant heat exchanger.

19. A condenser heat exchanger of claim 18.

20. An evaporator heat exchanger of claim 18.

21. A method of making a plastic tube heat exchanger of claim 4 involving winding a set of at least three thermoplastic tubes in a helical manner around a surface having the shape of a closed curve defining an aperture, with said tubes on a multiplicity of spaced-apart spacers which hold said tubes in a spatial relation to each other, said spacers providing a generally planar base, to form a layer of tubes, said base being generally perpendicular to said surface, wherein the set of tubes is positioned on said base in a generally planar relation to form a layer, with a first tube in said layer having an inward side adjacent said surface and an outward side opposite the inward side, a second tube in said layer proximate the first tube and on the outward side of said first tube

opposite said surface, and each succeeding tube on the spacers with an inward side proximate the outward side of previous tube, with a first end of each of said tubes projecting off the base so that they can be joined together in a first header, and with the steps of:

arranging said tubes in the described configuration,

positioning said tubes relative to each other so that the layer of tubes winds around the surface,

when the layer of tubes is about to reach the part of said tubes that projects off of said base, adjusting the elevation of the set of tubes relative to the plate if needed so the next layer of tubes lies on the first layer of tubes with the first tube adjacent said surface,

repeating the previous step so that a tube group having a multiplicity of layers is formed, each overlaying the previous layer,

providing a termination of said set of tubes to provide a second end of each tube, and

joining together the first end of said tubes to form said first header and joining together said second end of said tubes in a second header.

22. The method of claim 21 wherein said surface is generally circular.

23. The method of claim 21 wherein said surface has a curvilinear shape other than generally circular.

24. The method of claim 23 wherein said surface has a shape generally in the nature of a figure eight.

25. The method of claim 21 wherein a multiplicity of spaced-apart spacers are provided on top of each layer, configured so as to provide spacing both between tubes in a layer and between layers.

26. The method of claim 25 wherein at least three spacers are provided on each layer.

27. The method of claim 26 wherein the spacing between tubes within a layer is less than the spacing between layers.

28. The method of claim 21 wherein the steps are repeated to form a multiplicity of tube groups, each with its own terminations.

29. The method of claim 21 wherein each row has from 3 to 100 tubes.

30. The method of claim 27 wherein each row has 15 to 20 tubes.

31. The method of claim 21 wherein each tube group has from 4 to 10 layers of tubes.

32. The method of claim 28 wherein the number of tube groups provided is from 3 to 10.